HL1 Mid-Year Final – Paper 2 MS

1. (a) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$; 2

*Award **[1]** for formulas and **[1]** for coefficients.*

(b) (CO_2 produced) = 200 (cm^3);

(O_2 remaining) = 100 (cm^3); 2

ECF from 2(a).

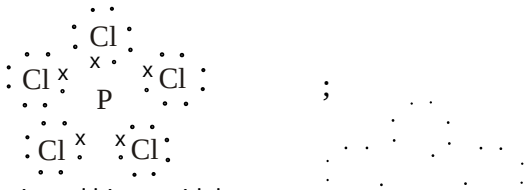
[4]

2. (i) (chlorine has) an extra proton/more protons/greater nuclear charge/ 17+ compared to 16+;
outer electrons attracted more strongly; 2

(ii) ability of atom to attract bonding pair of electrons/electrons in a covalent bond;
chlorine has a smaller radius/(electrons) closer to nucleus/in lower energy level;
repelled by fewer inner electrons/decreased shielding effect; 3

[5]

3. (i)



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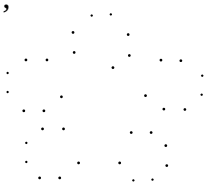
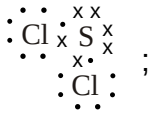


trigonal bipyramidal;
90□;
120□;
180□; 3

*Award **[1]** for 2 correct bond angles.*

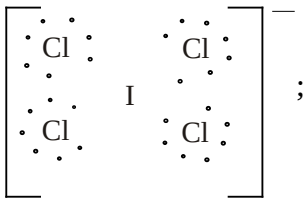
(ii)



;

Bent/angular/V-shaped;
100□□107□; 3

(iii)



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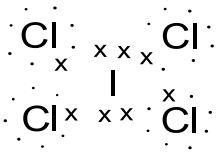

square planar;
90□; 3

No ECF allowed.

*Penalize once only **[1]** mark for missing lone pairs.*

Accept structures using lines to represent bonding and lone electron pairs.

[9]

4. (a) $M(BaSO_4)$ (= 137.34 + 32.06 + 4(16.00)) = 233.40 (g mol^{-1}□);

Accept 233.4 but not 233

n($BaSO_4$) $\left(=\frac{0.672\ g}{233.40\ g\ mol^{-1}}\right)$ = 0.00288 / 2.88×10^{-3}□(mol); 2

ECF from M value

(b) n (alkali metal sulfate) = 0.00288 / 2.88×10^{-3}□(mol); 1

ECF

(c) $M = \left(\frac{m}{n} = \frac{0.502\,g}{0.00288\,mol} = \right)$ 174.31 / 174.3 / 174;

ECF

units: g mol^{-1}; 2

(d) $(2(A_r) + 32 + 4(16) = 174$, thus) $A_r = 39$ / $A_r = \left(\frac{(174 - (32 + (4 \times 16))}{2} \right) = 39$;

Accept answer between 38.9 and 39.2
ECF
potassium/K;
ECF from A_r value

2

(e) $K_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2KCl(aq)$ 2

*Award **[1]** for balanced equation and **[1]** for state symbols*
ECF if another alkali metal arrived at in (d)
Accept net ionic equation
*If no answer arrived at in (d), but correct equation given involving any alkali metal, then award **[1 max]***

[9]

5. (i) +2 and +3/Fe^{2+} and Fe^{3+};

both s electrons are lost giving Fe^{2+} **and** one more d electron is also lost to form Fe^{3+}; 2

(ii) presence of unpaired electrons;
the d orbitals are split into two energy levels;
electrons move between these energy levels;
electrons can absorb energy from light of visible wavelength /*OWTTE*; 3

*Award **[1]** each for any three.*

[5]

6. (i) $1s^2 2s^2 2p^6 3s^2 3p^6$; 1

Do not accept [Ne] $3s^2 3p^6$ *or* 2, 8, 8.

(ii) K^+ /Ca^{2+} /Sc^{3+}/Ti^{4+};
Cl^-/S^{2-}/P^{3-}; 2

Accept other suitable pairs of ions.

[3]

7. (i)

C	N	H
$\frac{62.0}{12.01} / 5.16$	$\frac{24.1}{14.01} / 1.72$	$\frac{13.9}{1.01} / 13.8$

*Award **[2]** for above.*
No penalty for use of whole number atomic masses.
If atomic numbers used then only mark for % of H can be awarded.
*If H % and calculation missing, award **[1]**, and last mark cannot be scored.*
If H % calculation incorrect apply ECF.

C_3NH_8; 3

*Correct empirical formula scores **[3]**.*

(ii) the average mass of a molecule;

compared to 1/12 of (the mass of) one atom of ^{12}C/compared to C-12 taken as 12;

OR

$$\frac{\text{average mass of a molecule}}{\text{mass of 1/12 of one atom of } ^{12}C}$$

2

*Award **[2]** for the equation above.*

(iii) $C_6N_2H_{16}$; 1

[6]

8. (a) IV < I < II < III/
ultra violet radiation < yellow light < red light < infrared radiation; 1

(b) A continuous spectrum has all colours/wavelengths/frequencies whereas a line spectrum has only (lines of) sharp/discrete/specific colours/ wavelengths/frequencies; 1

(c) UV-B radiation has shorter wavelength;
hence, has higher energy;
increases risk of damage to skin cells/OWTTE/causes cancer; 3

[5]

9. (i) $n(C)(= n(CO_2) = 2.68\text{ g} \div 44.01\text{ g mol}^{-1}) = 0.0609\text{ mol}$;

$n(H)(= 2 \times n(H_2O) = 0.657\text{ g} \div 18.02\text{ g mol}^{-1}) = 0.0729\text{ mol}$;

$m(C) = 0.0609\text{ mol} \times 12.01\text{ g mol}^{-1} = 0.731\text{ g}$

and $m(H) = 0.0729\text{ mol} \times 1.01\text{ g mol}^{-1} = 0.0736\text{ g}$;

m(O) = (1.00 □0.731 □0.0736)g = 0.195g;

n(C)	n(H)	n(O)
0.0609	0.0730	0.195
		16.00
0.0609	0.0730	0.0122
0.0609	0.0730	0.0122
0.0122	0.0122	0.0122
4.99	5.98	1.00;

empirical formula: C_5H_6O; 6

*For C_5H_6 award **[4 max]**.*

Steps used to arrive at the correct amounts (in moles) are required for full marks.

(ii) $M(\text{crocetin}) = 98.5\text{ g} \div 0.300\text{ mol} = 328\text{ (g mol}^{-1})$;

$(\frac{328}{82.11} = 4)$

molecular formula: $C_{20}H_{24}O_4$; 2

ECF from (i).

[8]